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NATIONAL DAM SAFETY PROGRAM. PERONA LAKE DAM, NUMBER 1 (NJ-0029--ETC(U)
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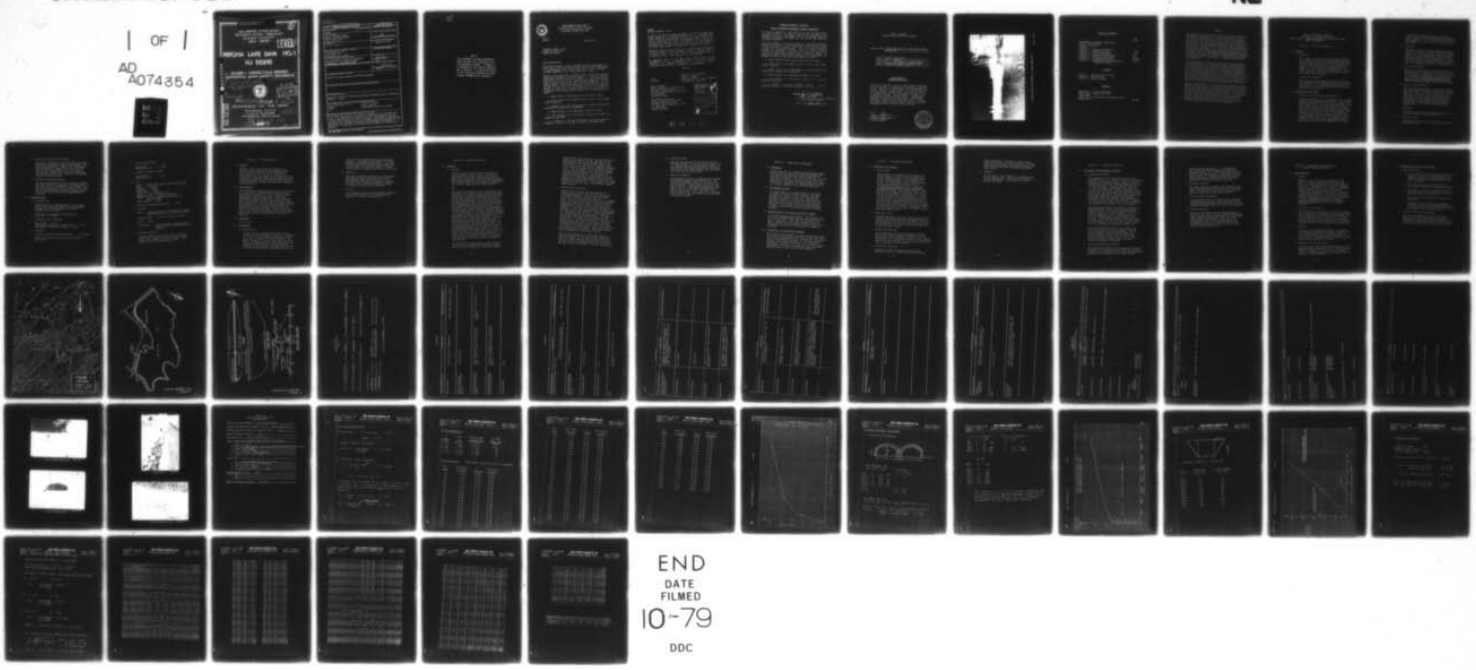

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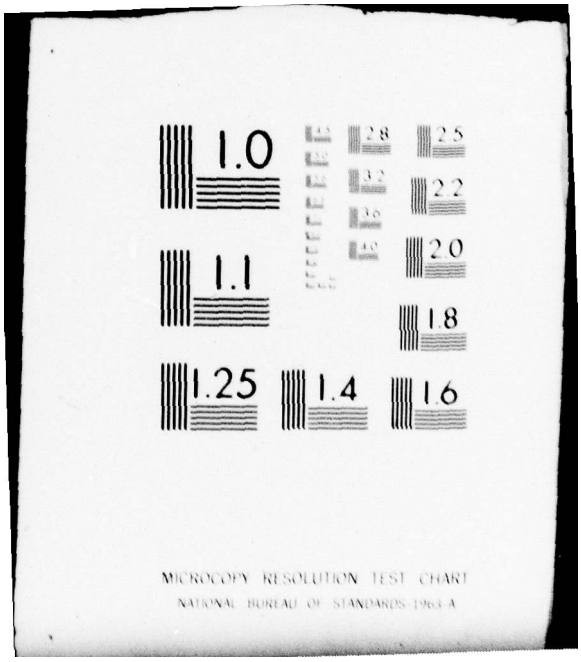
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SUSSEX COUNTY
NEW JERSEY

LEVEL II

# PERONA LAKE DAM NO. 1

# NJ 00295

## PHASE 1 INSPECTION REPORT
## NATIONAL DAM SAFETY PROGRAM.

Perona Lake Dam, Number 1 (NJ-00295)
Delaware River Basin, Pequest River,
Tributary, Sussex County, New Jersey.
Phase 1 Inspection Report.

(9) Final rept.

(10) F. Keith /Jolls







(15) DACW61-79-C-0011

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Perona Lake Dam No. 1, N.J.
Parapet
Dams
Structural Analysis
Visual Inspection
National Dam Inspection Act Report

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

17 SEP 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Perona Lake Dam No. 1 in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Perona Lake Dam No. 1, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in fair overall condition and the spillway is considered adequate. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. However, to assure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Debris should be removed from the inlet and pipe outfall.

b. Minor cracks in the exposed concrete in the culvert bridge should be repaired.

c. Cracks in the crest paving should be resealed and trees and brush should be removed from the embankment.

d. Rodent burrows on the downstream slope should be filled.

e. The collapsed brick and masonry parapet wall should be repaired or demolished.

f. A checklist of periodic maintenance inspections should be developed so records of conditions and repairs can be maintained.

NAPEN-D
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

Joel T. Callahan

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

## PERONA LAKE DAM NO. 1 (NJ00295)

## CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 3 May 1979 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Perona Lake Dam No. 1, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in fair overall condition and the spillway is considered adequate. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. However, to assure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Debris should be removed from the inlet and pipe outfall.

b. Minor cracks in the exposed concrete in the culvert bridge should be repaired.

c. Cracks in the crest paving should be resealed and trees and brush should be removed from the embankment.

d. Rodent burrows on the downstream slope should be filled.

e. The collapsed brick and masonry parapet wall should be repaired or demolished.

f. A checklist of periodic maintenance inspections should be developed so records of conditions and repairs can be maintained.

APPROVED: Joel T. Callahan

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

DATE: 13 September 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Perona Lake Dam No. 1 Fed ID# NJ 00295
NJ ID# 143

State Located New Jersey
County Located Sussex
Coordinates Lat. 4101.2 - Long. 7441.8
Stream Unnamed tributary of Pequest River
Date of Inspection May 3, 1979

## ASSESSMENT OF GENERAL CONDITIONS

Perona Lake Dam No. 1 is in a fair overall condition and the spillway is adequate to transmit the design flood. The dam is recommended to be downgraded from a high hazard to a low hazard. Overtopping would not appreciably increase the danger of loss of life or property damage. No detrimental findings were uncovered to warrant further study. Recommended remedial measures to be undertaken in the future include 1) remove debris from the inlet, 2) reseal the crest paving 3) remove trees and brush from the embankment and 4) seal up rodent burrows.

F. Keith Jolls P.E.
Project Manager

OVERVIEW OF PERONA LAKE DAM NO. 1

MAY, 1979

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## FIGURES



## APPENDIX

# PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the establisned Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: PERONA LAKE DAM NO. 1 FED ID #NJ 00295
AND NJ ID #143

## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Corps of Engineers, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of Perona Lake Dam No. 1 and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

### 1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Perona Lake Dam No. 1 is a 470 foot long, earthen structure with a concrete corewall. The corewall extends from elevation 756.2 down to bedrock or firm glacial till. On the centerline axis of the dam, tongue and groove wood sheeting has been driven to a depth seven feet below the corewall. The face of the dam is protected by riprap from elevation 756.2 to the toe. A 12" diameter, cast-iron drain pipe at invert elevation 741.5 is controlled from a reinforced concrete valve chamber on the dam crest. An ungated concrete spillway is cut into the bedrock below a two cell culvert at the right abutment. The crest

of the dam is paved and acts as an access road to a home several hundred feet beyond the right abutment. A low stone and brick barrier wall extends along the lakeside edge of the dam crest.

b. Location

The dam is located on an unnamed tributary of the Pequest River in Andover Township, Sussex County. It is approximately 3.4 miles southwest of the center of Sparta and 2.9 miles southeast of the Newton Town boundary. This dam, together with Perona Dam No. 2 (NJ 00294) form the northerly boundary of Perona Lake which is situated just west of County Road 517.

c. Size Classification

Dam No. 1 at Perona Lake has a maximum height of 17 feet and a maximum storage capacity of 149 acre-feet. Accordingly, this dam is placed in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

The only facility between the dam and a larger lake one mile downstream is a lightly traveled secondary road. With the exception of one new home on the fringe of the flood plain, the downstream area is uninhabited and quite ill-defined as it flows thru a level flat area. Accordingly, it is recommended both dams at Perona Lake be downgraded to a low hazard classification (the same classification as Dam No. 2).

e. Ownership

This dam is owned by G. Robert Compton, R.D. 1, Box 763, Newton, New Jersey 07860.

f. Purpose of Dam

The purpose of the dam is to impound a private recreation lake.

g. Design and Construction History

The dam was designed in 1929 by Snook and Hardin, Engineers & Surveyors, Newton, New Jersey. The design was approved in April 1929 and construction completed in August 1929. The two-cell culvert was constructed over the spillway in 1930 without proper permit but final approval was granted in July 1931. There is no recorded history of modifications.

h. Normal Operating Procedures

The dam is maintained jointly by Messrs. Compton and Perona (owner of Dam No. 2) and regulation of the water level is performed by Mr. Perona. The lake is lowered every fall to protect the walls on the lake perimeter against ice damage as well as to facilitate whatever maintenance may be required.

## 1.3 PERTINENT DATA

a. Drainage Area

Perona Lake has a drainage area of 0.11 square miles which consists primarily of undeveloped woodland and includes another lake with a surface area of 5 acres.

b. Total spillway capacity at maximum pool elevation - 183 cfs

c. Elevations (ft. above MSL)

Top of dam - 757.2
Recreational pool and spillway crest - 754.7
Streambed at centerline of dam - 740±

d. Reservoir

Length of maximum pool (top of dam) - 1,950 feet

Length of recreation pool (spillway crest) - 1,700 feet

e. Storage (acre-feet)

| | | |
|---|---|---|
| Top of dam | - | 149 |
| Recreation pool | - | 101 |

f. Reservoir Surface (acres)

| | | |
|---|---|---|
| Top of dam | - | 22 |
| Recreation pool | - | 17 |

g. Dam

Type - Earth with concrete core and spillway.
Length - 470 feet
Height - 17 feet
Top Width - 8 feet
Side Slopes - 2H:1V
Zoning - (see attached plans)
Impervious Core - Concrete corewall
Cutoff - T&G wood sheeting beneath core in center of dam.
Grout curtain - None

h. Diversion and Regulating Tunnel - None

i. Spillway

Type - Broad-crested weir on bedrock at right abutment beneath two cell arch culvert.

Channel width - 16 feet (2 @ 8 feet each)

Gates - None

D/S Channel - Steep, wingwall guided channel near interface of embankment and bedrock.

j. Regulating Outlets

12-inch diameter C.I. drain pipe at entrance invert 741.5 controlled from reinforced concrete valve chamber in center of dam. Outlet invert elevation approximately 740.5.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

Details of the design were contained in the original plans filed with Dam Application No. 143 in 1929 although no design computations were available. In view of the height to width ratio, the dam appears to be conservatively designed. No design plans were available for the bridge structure over the spillway but this has no bearing on the safety aspects of the inspection (see Section 6).

### 2.2 CONSTRUCTION

The construction appeared to have been carried out in a workmanlike fashion from a review of the Department's inspection reports and microfilmed photographs taken at that time. Where the underlying bedrock dipped down in the middle of the natural channel, timber sheeting was driven below the concrete cut-off wall to further reduce the permeability. The spillway was widened during construction and the present culvert above it apparently was added without official approval before the dam was completed. The architectural wall on the crest was constructed at a later date, apparently without any engineering design of a footing.

### 2.3 OPERATION

See Section 4.

### 2.4 EVALUATION

a. Availability

In view of the original configuration and because the dam is founded primarily on bedrock, it is felt that sufficient engineering data is available to assess the design aspects. The dam is situated in an area underlain by a thin mantle of glacial moraine deposited during the Wisconsin glacial event. This heterogenic mixture is less than 10 feet thick and is composed of unconsolidated, unstratified clay and

silt and some granular sands and occasional boulders. The underlying bedrock is a metamorphic Pre-Cambrian Byram gneiss. The rock is very dense and hard and forms much of the highland area of northwest Jersey. Perona Lake occupies a natural depression in the rock.

b. Adequacy

The field inspection and review of the available design plans reveal that the dam is structurally sound and well-built. It is believed that the data available is adequate to render this assessment without recourse to gathering additional information.

c. Validity

The validity of the engineering data available is not challenged and is accepted without recourse to further investigations.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

a. General

Visual inspection of Perona Lake Dam No. 1 was conducted on May 3, 1979. The overall condition of the dam was reviewed with its owner who pointed out localized problem areas and remedial measures that have been undertaken. The overall condition of the dam is generally fair and is stable and well-established.

b. Dam

The crest of the dam has been widened two feet and paved with asphalt since the original construction. An architectural masonry and brick guard wall has been built along the lakeside of the crest and small trees planted on the downstream embankment. The thin asphalt overlay covering the crest is severely cracked and in an advanced state of deterioration. Some settlement of the embankment has occurred as indicated by a crown (roughly at the centerline) several inches higher than the pavement edges. It was noted that the concrete corewall extends to within one foot of the crest and is no doubt supporting the center of the paving. The settlement of the adjacent roadway is possibly due in part to compaction resulting from vehicular crossings on the crest roadway for several decades. The deteriorated stone wall is tilted toward the lake and a thirty foot section has collapsed. The cause of this can be attributed to two major factors: muskrat burrowing under the outer edge of the wall just below the water line and frost heave (also resulting in the pavement deterioration). The broken section of wall collapsed in February 1979 during an extended period of unusually cold weather.

The crest of the embankment at the backslope is covered with vegetation and trees ranging from 2" to 8" in diameter. Numerous rodent

burrows were noted near the toe and some minor erosion is occurring at the junction of the left abutment and the embankment due to the existence of a 6" diameter storm drain (some 8 to 9 feet below the crest). Bedrock outcrops to the left and immediately downstream of this drain. The alignment of the backslope appears in satisfactory condition as does the riprap covered upstream slopes. No sloughing or settlement was noted on either slope below the crest. The low terrain beyond the toe of the backslope is damp and true swamp conditions were observed beyond the toe. This appears to be the result of a natural water table and not embankment seepage.

c. Appurtenant Structures

Normal pool elevation is maintained by an uncontrolled spillway cut into the bedrock at the right abutment. The spillway originally consisted of an open 20 foot long weir of which 60% is exposed bedrock and 40% is a concrete slab. Following completion of the dam a masonry and brick bridge with a central pier was constructed across the spillway. This effectively reduced the spillway to two 8-foot wide arch culverts. A 36 foot long concrete wingwall forms the left wall of the discharge channel protecting the embankment from erosion. Flow in the channel is confined between the wingwall and bedrock which forms the right culvert wall. The deck of the bridge is spalled as are portions of the center pier. The wingwall exhibits several small surface cracks as well as a ½" wide, vertical structural crack where it has pulled away from its junction with the culvert wall. The center pier appears in satisfactory structural condition as it is founded on bedrock. Some light debris has accumulated at the spillway crest.

The 12-inch diameter C.I. drain pipe was not visible although the concrete valve chamber and outlet structure are in satisfactory condition with only light efflorescence noted on the walls. The gate valve is operated every year to lower the lake level and appears to be well maintained.

d. Reservoir Area

The lake and most of its shoreline are the property of the two parties who own Dams 1 and 2. Consequently, the surrounding terrain is essentially undeveloped and heavily forested. The slopes rise rather steeply from the shoreline but are well stabilized.

e. Downstream Channel

The discharge channel is somewhat constricted by bedrock outcrops and mature trees. All spillway discharge follows a path along the left wingwall of the spillway to the low area beyond the toe. The channel downstream from this point is ill-defined and eventually becomes a marsh and inflow originates from several directions. Only one home is located near enough to the main channel to constitute a potential hazard.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

Perona Lake Dam No. 1 functions essentially uncontrolled with the ungated spillway accommodating the slight fluctuations of water level due to seasonal variations. The lake is generally lowered each fall in order to permit repair work to the nearby retaining walls and dam as well as to avoid ice damage. Regulation is accomplished utilizing the 12-inch diameter cast iron blow-off pipe.

### 4.2 MAINTENANCE OF DAM

The responsibility for maintenance of this dam is shared jointly by Messrs. Compton and Perona although the latter is more familiar with the operational features of the dam. Maintenance normally consists of cutting the growth on the backslope, pruning the trees near the crest and minor patching and/or pointing of deteriorated concrete. The asphalt roadway has been allowed to deteriorate to a point of complete structural failure.

### 4.3 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

No formal warning system exists. The owner lives only a few hundred feet from the dam and must cross it every day as it forms the only access to his home. Accordingly, any severe deterioration or abrupt change in the structure would be noted and presumably corrected or ameliorated by lowering the lake.

### 4.4 EVALUATION OF OPERATIONAL ADEQUACY

While the blow-off conduit is only opened seasonally, the owner is continually available to lower the lake level should problems arise. Accordingly, the present system is considered adequate for the recreational purposes and a warning system is not considered necessary. However, it is felt that a more in-depth application of routine maintenance could stem the deterioration of this 50 year old structure.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

a. Design Data

The spillway is a double cell concrete weir approximately 16 feet wide which discharges under a masonry bridge. The hydraulic drop to the sloping bedrock invert beneath the bridge is approximately 3 feet and the bridge is more than adequate hydraulically to accommodate the spillway flows. Based upon the Recommended Guidelines for the Safety Inspection of Dams, the design flood is determined to be a 100-year frequency flood as the dam is in the small size category and in the downgraded low hazard classification. Inflow to the reservoir was calculated utilizing precipitation data from Technical Publication 40 and NOAA Tech. Memo NWS Hydro-35 by the HEC-1 program which yielded a peak inflow of 575 cfs. Routing this storm through the reservoir reduced the discharge flow to 54 cfs. Therefore, the spillway capacity of 183 cfs can safely accommodate the design flood.

b. Experience Data

Although the dam has been the subject of certain problems regarding ownership and maintenance, no actual storm flows have been recorded. The 1929 Dam Application indicated a design flood of about 95 cfs but there is no available field substantiation for this value.

c. Visual Observations

The spillway and the irregular bedrock invert beneath the bridge appears to operate satisfactorily and show no evidence of damage from excess velocities. The downstream channel is not scoured out as the flow discharges into a flat swampy area with no clearly defined channel.

d. Overtopping Potential

Based on the design discharge and spillway capacity, there is little liklihood of the dam

being overtopped. Inasmuch as Perona Dams 1 and 2 are at the same crest elevation, if overtopping should occur, the discharge would flow over several localized low spots along each dam's crest.

e. Drawdown

At the present time drawdown is possible thru the 12" sluice gate. Utilizing this outlet, it is estimated that it would take 11 days to dewater the lake.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

The alignment of the dam crest appears to be satisfactory as it is stabilized to a considerable degree by the asphalt paving. However, due to collapse of the architectural masonry wall along the upstream face, the lake edge of the crest is very irregular. Approximately 30 feet of the wall has collapsed and the remainder is in a very poor condition. However, this has little effect upon the structural integrity of the dam. The asphalt pavement is badly disintegrated and vehicular loads have produced considerable settlement along its entire length immediately in front of the concrete cut-off wall. However, the riprapped lake slope shows little indication of differential settlement or slope failure.

The grassed backslopes are stable but are brush covered along the edges and contain numerous rodent burrows. The right downstream bridge wingwall shows some minor erosion. There is a 6" pipe underdrain at the downstream toe of the left abutment but the inlet could not be located. The concrete manhole which houses the 12" gate valve (see Figure 3) is in good condition considering its age and the outlet appears to be in satisfactory operating condition.

The two-cell masonry culvert which spans the principal spillway shows its age but because it is founded on the exposed bedrock, has no major structural cracks except at the downstream wingwalls which were apparently cast monolithically with the arches. The joints at the re-entrant corners contain numerous voids and should be recaulked.

b. Design and Construction Data

The plans filed with the 1929 Permit Application indicate that the dam was conservatively designed although no computations were available for review. Based upon the condition of the dam, hazard

classification and size, it is believed that additional structural studies and analyses are unnecessary. It is noted that the spillway bridge, which was apparently constructed without legal permit, is of unknown structural quality but is believed to be adequate for the normal vehicular loadings which cross the crest.

c. Operating Records

No formal operating records were located or any knowledge obtained as to when repairs have been made. As previously stated, the lake level is lowered each year to make minor repairs.

d. Post Construction Changes

At the present time, no modifications are being considered by the Owner. Except for the architectural embellishments, there have been no major structural changes since the initial construction.

e. Seismic Stability

The dam is located in Zone 1 and experience indicates that dams will have adequate stability under dynamic loading conditions if stable under static loading conditions. Based on field observations and a review of the design and construction data, it is the opinion of the inspection team that this dam is stable under static loading conditions.

## SECTION 7 - ASSESSMENTS/RECOMMENDATIONS
## PROPOSED REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Perona Lake Dam No. 1 is classified as being in a fair overall condition. The embankment is built of unknown composition but due to its apparent impermeable state, concrete cut-off wall and lack of evidence of serious seepage, is felt to be of a sufficient impervious condition to withstand normal hydraulic heads. The present spillway capacity is adequate and meets the requirements of the Recommended Guidelines for Safety Inspection of Dams, transmitting the design flood as calculated by Corps of Engineers criteria.

b. Adequacy of Information

The information obtained for the Phase I inspection is deemed to be adequate and it is believed that little else is available. Performance data is also believed to be non-existent. However, in view of the hazard classification and downstream conditions, the information is considered satisfactory for the assessment contained herein.

c. Urgency

In view of the present conditions, no urgency is attached to implementing further studies and it is recommended that the remedial measures set forth below be taken under advisement in the future and be undertaken by the owner as part of his regular maintenance program.

d. Necessity for Further Study

In view of the recommended downgraded low hazard classification and the fact that little property damage is likely in the event of a collapse, further structural studies regarding the dam are believed to be unnecessary.

## 7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Recommendations

1) On the basis of the present conditions and geometry, remedial improvements to the existing spillway is not warranted. The debris should be cleaned out of the inlet and pipe outfall.

2) The minor cracks should be repaired on the exposed concrete in the culvert bridge.

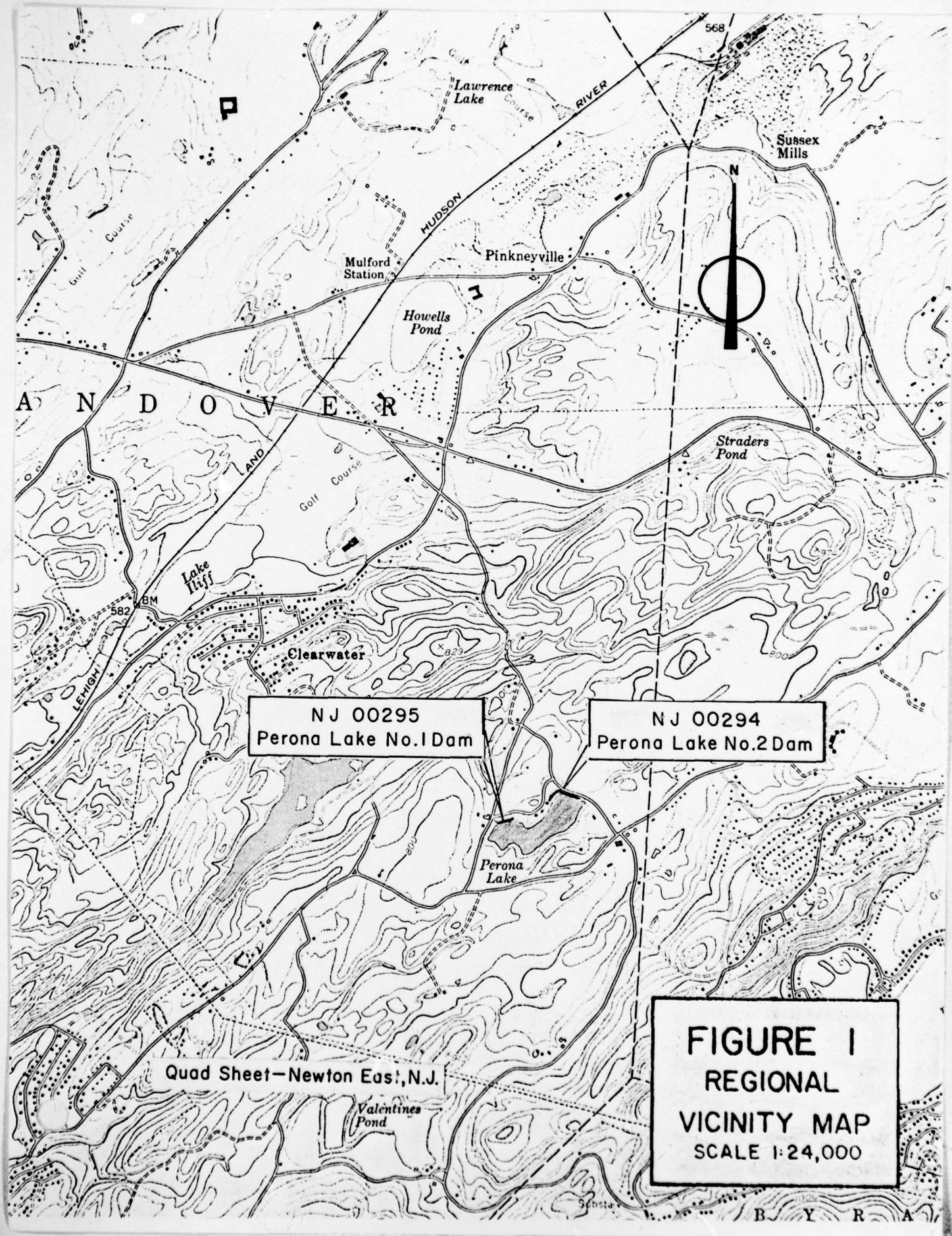
3) The cracks in the crest paving should be resealed and the trees and brush should be removed along the backslopes.

4) The rodent burrows should be filled on the backslopes.

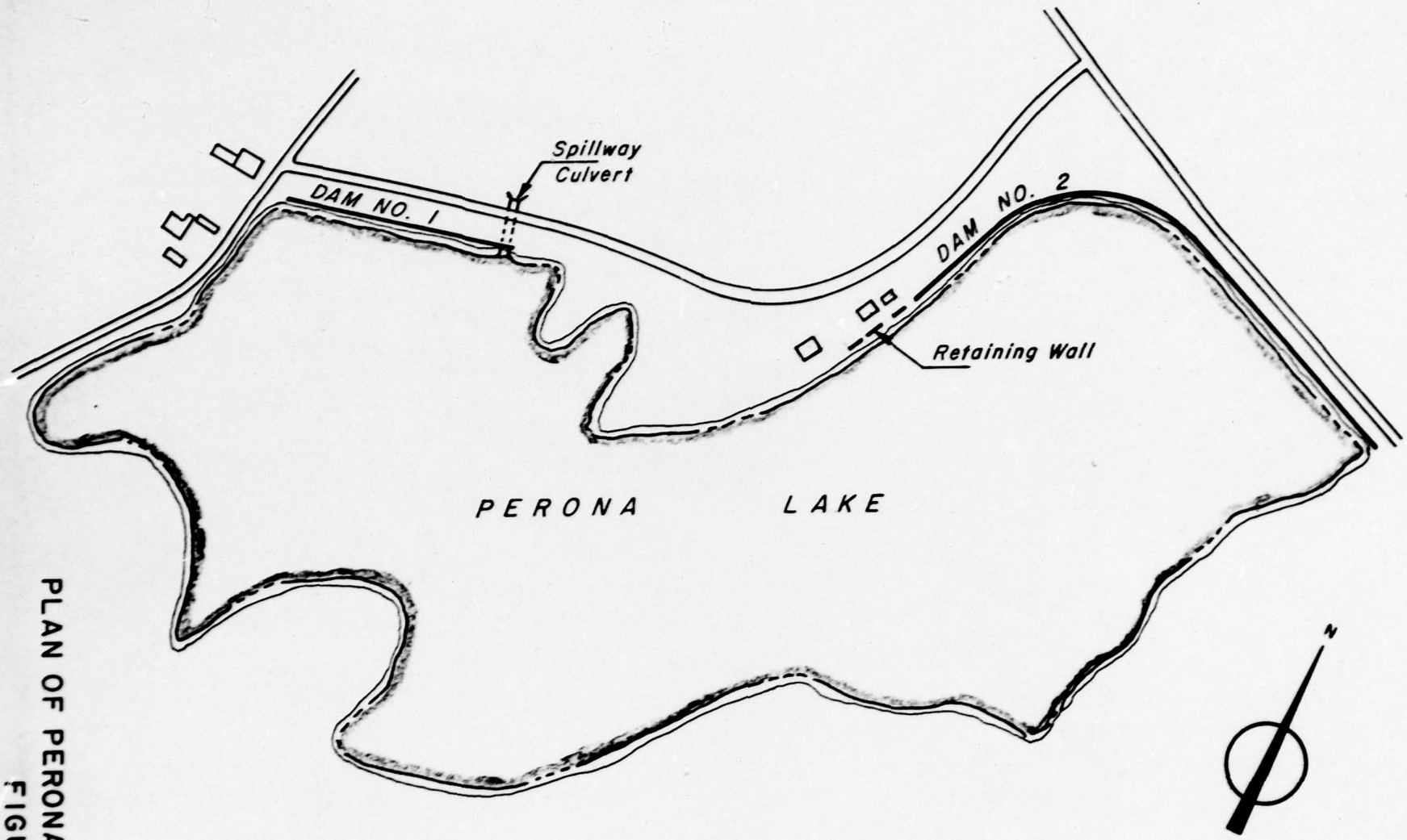
5) Although it has no affect on the dam's structural integrity, the collapsed brick and masonry parapet wall should be repaired or demolished at some future time.

b. O&M Maintenance and Procedures

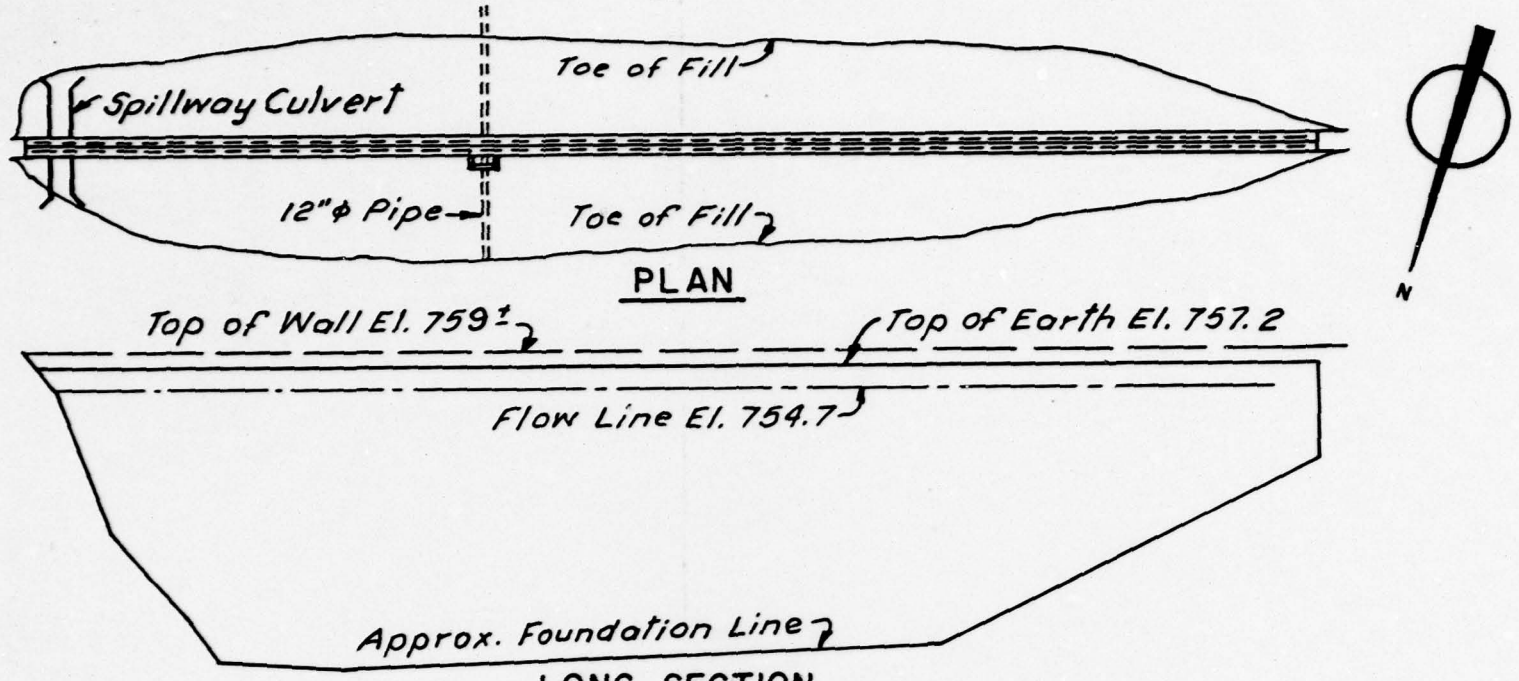
No additional procedures other than those presently in effect are warranted except it is recommended that a checklist of periodic maintenance inspections be developed so records of conditions and repairs can be maintained.

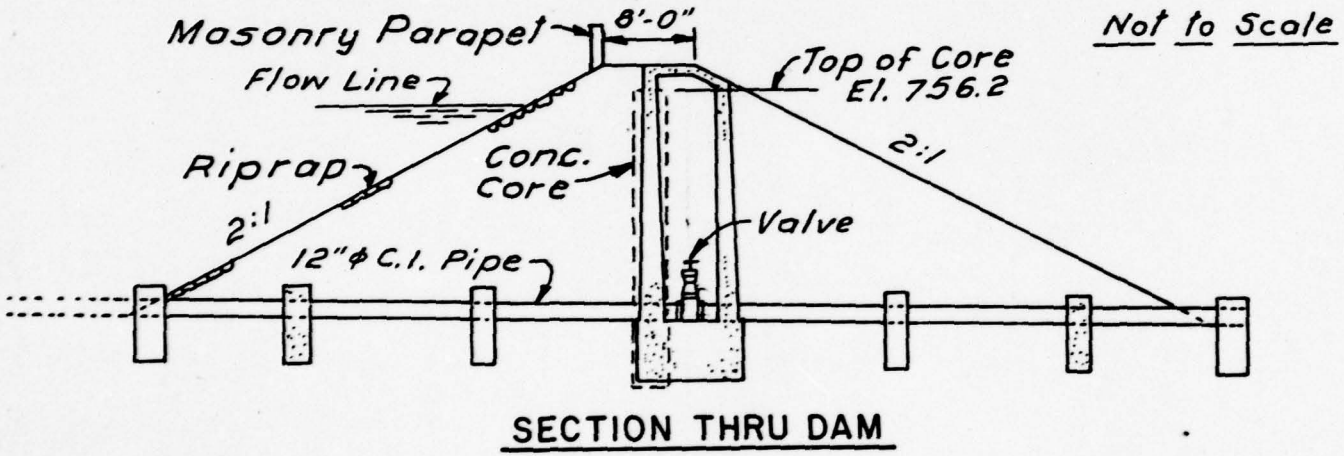



# FIGURE 1
## REGIONAL VICINITY MAP
SCALE 1:24,000




PLAN OF PERONA LAKE
FIGURE 2




Not to Scale

DETAILS OF DAM NO. 1
FIGURE 3

Check List
Visual Inspection
Phase 1

Name Dam Perona Lake #1 County Sussex State New Jersey Coordinators NJDEP

Date(s) Inspection 5/3/79 Weather Overcast Temperature 60°

Pool Elevation at Time of Inspection 754.7 M.S.L. Tailwater at Time of Inspection 738± M.S.L.

Inspection Personnel:

T. Chapter K. Jolls

D. Mulligan Mrs. G.R. Compton (owner)

K. Greenfield

T. Chapter Recorder

## EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SURFACE CRACKS | None visible in embankment | Paved crest severely cracked |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | None observed. | |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | Minor gullies at left abutment due to 6-inch storm drain 8'-9' below crest | Inlet drain could not be located. |
| VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST | Vertical alignment good - Horizontal good with exception of slight frost heave. | |
| RIPRAP FAILURES | None | |

## EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| EXCESSIVE SHRUB GROWTH, TREES, ETC. | Growth along entire backslope; 8" Ø trees and heavy brush at toe | Earth damp in some areas |
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | Satisfactory | |
| ANY NOTICEABLE SEEPAGE | None visible | |
| STAFF GAGE AND RECORDER | None | |
| DRAINS | 6" storm drain entering at left abutment. | |

OUTLET WORKS

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT | Headwall and conduit satisfactory; On bedrock; No spalling or cracking observed; Light silting; Iron precipitate in discharge | |
| INTAKE STRUCTURE | Not visible | |
| OUTLET STRUCTURE | Satisfactory | |
| OUTLET CHANNEL | Outfall discharges into low overgrown bog areas. | |
| EMERGENCY GATE | Gate chamber in good condition; Valve last opened in fall of 1978; Constant seepage past valve packing. | |

UNGATED SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONCRETE WEIR | Satisfactory - Light debris; weir is built on bedrock. | Debris should be removed. |
| APPROACH CHANNEL | Bedrock just below water surface between wingwalls. | |
| DISCHARGE CHANNEL | Flows over bedrock along retaining wall-channel overgrown with trees up to 12" in diameter. | |
| BRIDGE AND PIERS | Piers and bridge on rock. ½ inch crack at left downstream junction of retaining and wingwall. Deck of bridge over spillway spalled. Some deterioration of stonework. | Stonework needs repointing; cracks and spalling should be repaired. |
| | | |

RESERVOIR

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SLOPES | Steep slopes - well wooded - undeveloped. | |
| SEDIMENTATION | None visible | |

DOWNSTREAM CHANNEL

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONDITION (OBSTRUCTIONS, DEBRIS, ETC.) | Natural terrain - low swampy area - Poorly drained - heavily overgrown | |
| SLOPES | Flat and open | |
| APPROXIMATE NO. OF HOMES AND POPULATION | 1 home - stream drains through low marsh - New home constructed in flood plain has pond into which the swamp and lake drains. | |

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

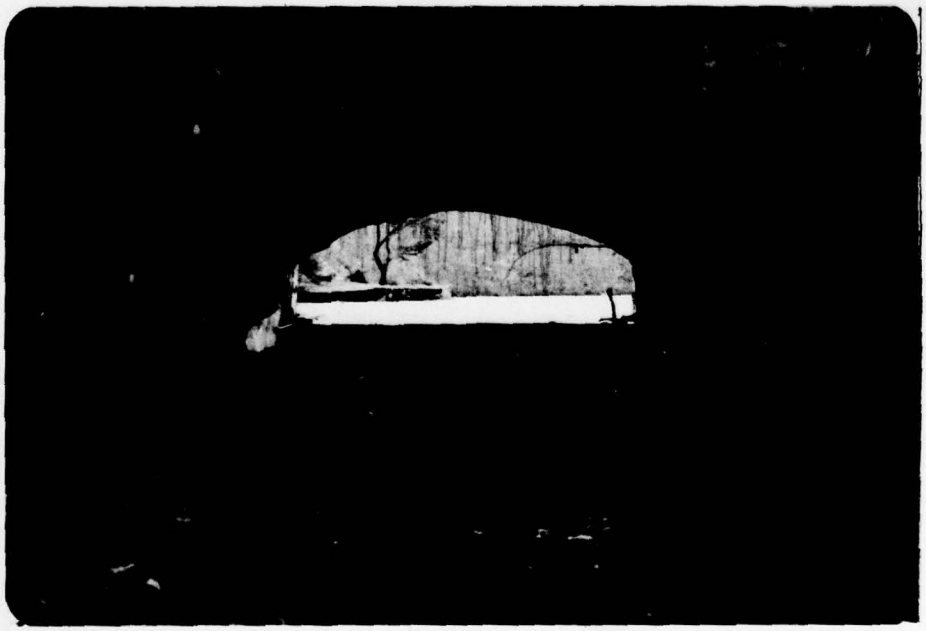
| ITEM | REMARKS |
|---|---|
| PLAN OF DAM | Available - NJDEP - Division of Water Resources, Bureau of Flood Plain Management, Trenton, N.J. |
| REGIONAL VICINITY MAP | Available - USGS Quad Sheet - Newton East, N.J. |
| CONSTRUCTION HISTORY | Available - NJDEP - Div. Water Resources - Bureau Flood Plain Management |
| TYPICAL SECTIONS OF DAM | " " " " " " " " " |
| HYDROLOGIC/HYDRAULIC DATA | " " " " " " " " " |
| OUTLETS - PLAN | " " " " " " " " " |
| - DETAILS | " " " " " " " " " |
| -CONSTRAINTS | Not Available |
| -DISCHARGE RATINGS | Not Available |
| RAINFALL/RESERVOIR RECORDS | Not Available |

| ITEM | REMARKS |
|---|---|
| SPILLWAY PLAN | Available - NJDEP -Div.Wtr Res. - Bur. Fld. Pln. Mngmt. |
| SECTIONS | " " " " " |
| DETAILS | " " " " " |
| OPERATING EQUIPMENT PLANS & DETAILS | Available - NJDEP - Div. Wtr. Res. - Bur. Fld. Pln. Management |

| ITEM | REMARKS |
|---|---|
| DESIGN REPORTS | Not Available |
| GEOLOGY REPORTS | Not Available |
| DESIGN COMPUTATIONS | Not Available |
| HYDROLOGY & HYDRAULICS | Available - NJDEP - Div. Wtr. Res. - Bur. Fld. Pln. Management |
| DAM STABILITY | Not Available |
| SEEPAGE STUDIES | Not Available |
| MATERIALS INVESTIGATIONS | Not Available |
| BORING RECORDS | Not Available |
| LABORATORY | Not Available |
| FIELD | Not Available |
| POST-CONSTRUCTION SURVEYS OF DAM | Not Available |
| BORROW SOURCES | Not Available |

| ITEM | REMARKS |
|---|---|
| MONITORING SYSTEMS | None Available |
| MODIFICATIONS | None Available |
| HIGH POOL RECORDS | None Available |
| POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS | None Available |
| PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS | None Available |
| MAINTENANCE OPERATION RECORDS | None Available |

View of Perona Lake Dam # 1 May, 1979



View of Spillway Outlet May, 1979

View of Crest May, 1979

View of Backslope of Dam May, 1979

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.11 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 754.7 (101 Ac. Ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 756.2

ELEVATION TOP DAM: 757.2 (149 Ac. Ft.)

CREST: Twin arch culverts under private road bridge

a. Elevation 754.7
b. Type 12" wide concrete slab laid on bedrock-Approach lip rounded
c. Width 2 @ 8' each
d. Height 2 @ 30" each
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type Gate operated 12" dia. C.I. pipe
b. Location 150' from left abutment
c. Entrance inverts 741.5
d. Exit inverts 740.5
e. Emergency draindown facilities Same

HYDROMETEOROLOGICAL GAGES: None
a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 183 cfs.

BY D.J.M. DATE 5-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF

CHKD. BY ____ DATE ____ PERONA LAKE DAMS 1 & 2 PROJECT C234

SUBJECT ____

Time of concentration:

Overland flow $L = 0.2$ miles $H \simeq 50'$

Slope = 4.7%

Assume velocity of 4 ft $s^{-1}$

gives $t_c = \frac{0.2 \times 5280}{4 \times 60} = 4.4$ minutes

By California culverts equation:

$$t_c = \left(\frac{11.9 \times 0.2^3}{50}\right)^{0.385} = 5.4 \text{ minutes}$$

use 5 minutes for $t_c$.

to find $t_p$, use increment of D = 5 mins (In other words, no points on the ascending portion of the unitgraph will be given. Only the peak and descending portion will be obtained).

$$t_p = \frac{0.08}{2} + 0.6 \times 0.08 = 0.09$$

Drainage Area.

$$Q_p = \frac{484 \times 0.11}{0.09} = 580.8 \text{ say } 581 \text{ cfs}$$

BY D.J.M. DATE 5-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A2 OF
CHKD. BY DATE PERONA LAKE DAMS 1 & 2 PROJECT C234
SUBJECT

Unit hydrograph:

| T hours | T/Tp | Dimensionless ordinate (D.O) | Q (cfs) (=Qp x D.O) |
|---|---|---|---|
| 0.083 | 0.922 | 0.980 | 569 |
| 0.167 | 1.856 | 0.390 | 227 |
| 0.250 | 2.778 | 0.100 | 58 |
| 0.333 | 3.700 | 0.028 | 16 |
| 0.417 | 4.633 | 0.008 | 5 |

Precipitation: (see depth-duration curve on page A5)

| Time (mins) | Precipitation (inches) | Δ (inches) | Rearrange Δ (inches) |
|---|---|---|---|
| 5 | 0.80 | 0.80 | 0.02 |
| 10 | 1.28 | 0.48 | 0.02 |
| 15 | 1.70 | 0.42 | 0.02 |
| 20 | 1.94 | 0.24 | 0.02 |
| 25 | 2.17 | 0.23 | 0.02 |
| 30 | 2.40 | 0.23 | 0.02 |
| 35 | 2.54 | 0.14 | 0.02 |
| 40 | 2.67 | 0.13 | 0.02 |
| 45 | 2.80 | 0.13 | 0.02 |
| 50 | 2.90 | 0.10 | 0.02 |
| 55 | 3.00 | 0.10 | 0.02 |
| 60 | 3.10 | 0.10 | 0.02 |
| 65 | 3.20 | 0.10 | 0.03 |
| 70 | 3.30 | 0.10 | 0.02 |
| 75 | 3.40 | 0.10 | 0.03 |
| 80 | 3.50 | 0.10 | 0.03 |
| 85 | 3.60 | 0.10 | 0.03 |
| 90 | 3.70 | 0.10 | 0.03 |
| 95 | 3.76 | 0.06 | 0.03 |
| 100 | 3.81 | 0.05 | 0.03 |

3.86

BY D.J.M. DATE 5-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A3 OF

CHKD. BY ____ DATE ____ PERONA LAKE DAMS 1 & 2 PROJECT C234

SUBJECT ____

| Time (mins) | Precipitation (inches) | Δ (inches) | Rearrange Δ (inches) |
|---|---|---|---|
| 105 | 3.86 | 0.05 | 0.03 |
| 110 | 3.91 | 0.05 | 0.04 |
| 115 | 3.96 | 0.05 | 0.04 |
| 120 | 4.00 | 0.04 | 0.04 |
| 125 | 4.04 | 0.04 | 0.05 |
| 130 | 4.08 | 0.04 | 0.05 |
| 135 | 4.12 | 0.04 | 0.10 |
| 140 | 4.16 | 0.04 | 0.10 |
| 145 | 4.19 | 0.05 | 0.10 |
| 150 | 4.22 | 0.03 | 0.10 |
| 155 | 4.25 | 0.03 | 0.10 |
| 160 | 4.28 | 0.03 | 0.13 |
| 165 | 4.31 | 0.03 | 0.23 |
| 170 | 4.34 | 0.03 | 0.24 |
| 175 | 4.37 | 0.03 | 0.48 |
| 180 | 4.40 | 0.03 | 0.80 |
| 185 | 4.43 | 0.03 | 0.42 |
| 190 | 4.46 | 0.03 | 0.23 |
| 195 | 4.49 | 0.03 | 0.14 |
| 200 | 4.52 | 0.03 | 0.13 |
| 205 | 4.55 | 0.03 | 0.10 |
| 210 | 4.58 | 0.03 | 0.10 |
| 215 | 4.60 | 0.02 | 0.10 |
| 220 | 4.62 | 0.02 | 0.10 |
| 225 | 4.64 | 0.02 | 0.06 |
| 230 | 4.67 | 0.03 | 0.05 |
| 235 | 4.69 | 0.02 | 0.05 |
| 240 | 4.71 | 0.02 | 0.04 |
| 245 | 4.74 | 0.03 | 0.04 |
| 250 | 4.76 | 0.02 | 0.03 |
| 255 | 4.78 | 0.02 | 0.03 |
| 260 | 4.80 | 0.02 | 0.03 |

BY. D.J.M. DATE 5-79

CHKD. BY _____ DATE _____

SUBJECT _____

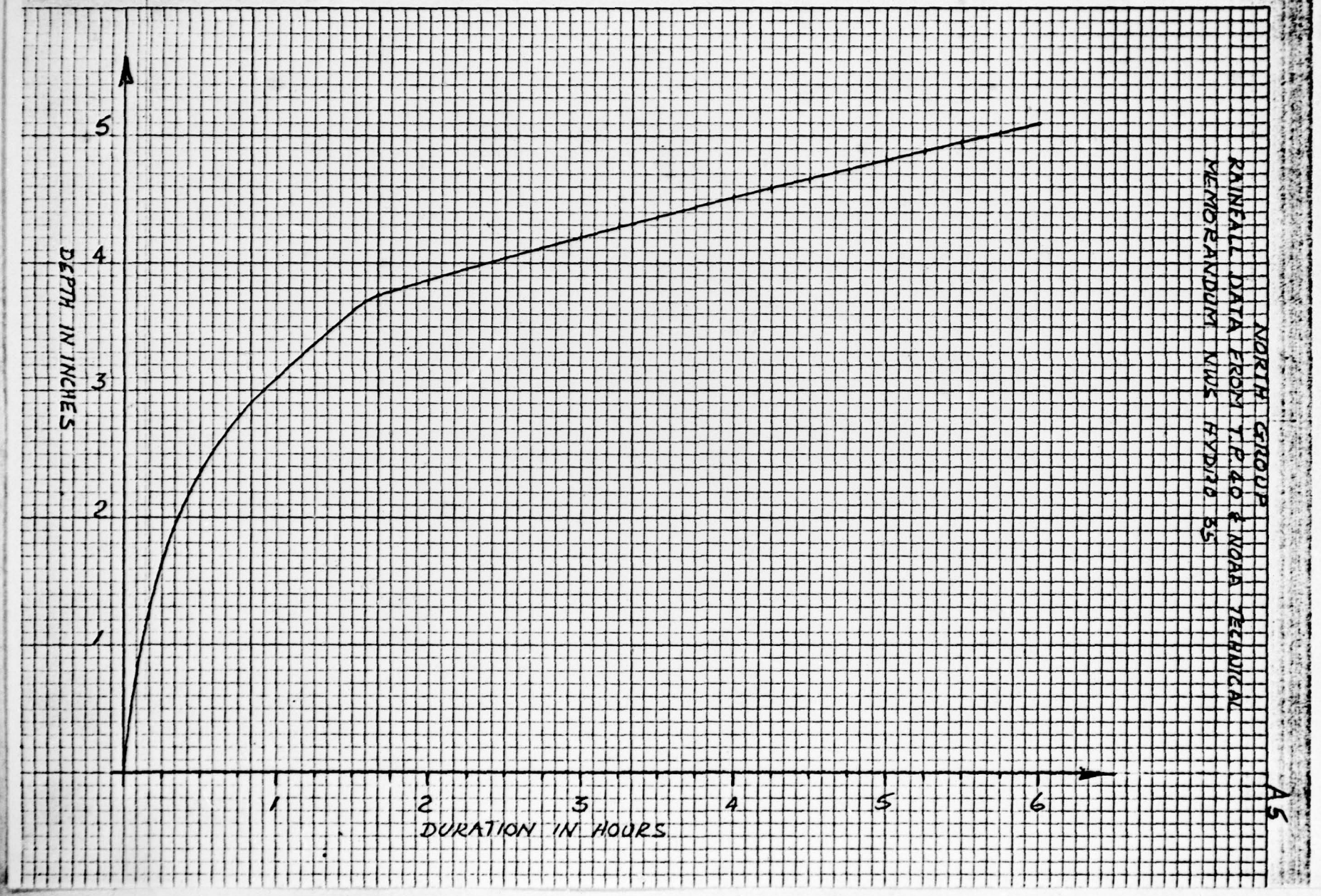
**LOUIS BERGER & ASSOCIATES INC.**

PERONA LAKE DAMS 1 & 2

SHEET NO. A4 OF

PROJECT C234

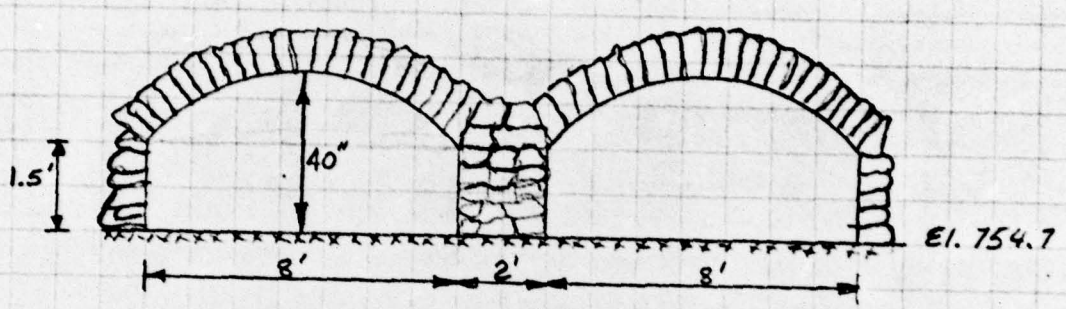
| Time (mins) | Precipitation (inches) | Δ (inches) | Rearrange Δ (inches) |
|---|---|---|---|
| 265 | 4.82 | 0.02 | 0.03 |
| 270 | 4.84 | 0.02 | 0.03 |
| 275 | 4.86 | 0.02 | 0.03 |
| 280 | 4.88 | 0.02 | 0.03 |
| 285 | 4.90 | 0.02 | 0.02 |
| 290 | 4.92 | 0.02 | 0.02 |
| 295 | 4.94 | 0.02 | 0.02 |
| 300 | 4.96 | 0.02 | 0.03 |
| 305 | 4.98 | 0.02 | 0.02 |
| 310 | 5.00 | 0.02 | 0.02 |
| 315 | 5.02 | 0.02 | 0.02 |
| 320 | 5.04 | 0.02 | 0.02 |
| 325 | 5.06 | 0.02 | 0.02 |
| 330 | 5.08 | 0.02 | 0.02 |
| 335 | 5.10 | 0.02 | 0.02 |
| 340 | 5.12 | 0.02 | 0.02 |
| 345 | 5.14 | 0.02 | 0.02 |
| 350 | 5.16 | 0.02 | 0.02 |
| 355 | 5.18 | 0.02 | 0.02 |
| 360 | 5.20 | 0.02 | 0.02 |



BY D.J.M. DATE 5-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A6 OF
CHKD. BY ____ DATE ____ PERONA LAKE DAM #1 PROJECT C234
SUBJECT ____

Spillway discharge calculations:

2 masonry arch spillways




Flow through arches

Weir flow $L = 16'$

Culvert flow

$C = 0.5$ $a \approx 220' \times 2$

| Elev | H. | C | Q | H | Q |
|---|---|---|---|---|---|
| 754.7 | 0 | 3.0 | | | |
| 755.7 | 1 | 3.0 | 48 | | |
| 756.2 | 1.5 | 3.0 | 88 | | |
| 757.2 | 2.5 | 2.9 | 183 | | |
| 758.2 | | | | 3.5 | 330 |
| 759.2 | | | | 4.5 | 374 |

For flow over dams:

Perona #2 dam is 915' long - crest El. = 757.2 $C = 2.7$

Perona #1 dam has 2' wall on top except for 35' breach in wall ∴ length = 35' @ El. 757.2 $C = 2.9$

length = 705' @ El. 759.2 $C = 2.9$

BY D.J.M. DATE 5-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A7 OF
CHKD. BY ____ DATE ____ PERONA LAKE DAMS PROJECT C234
SUBJECT ____

flow over Perona # 1 L = 35'

| Elev. | H | C | Q |
|---|---|---|---|
| 757.2 | 0 | 2.9 | 0 |
| 758.2 | 1 | 2.9 | 102 |
| 759.2 | 2 | 2.9 | 287 |

flow over Perona # 2 L = 915'

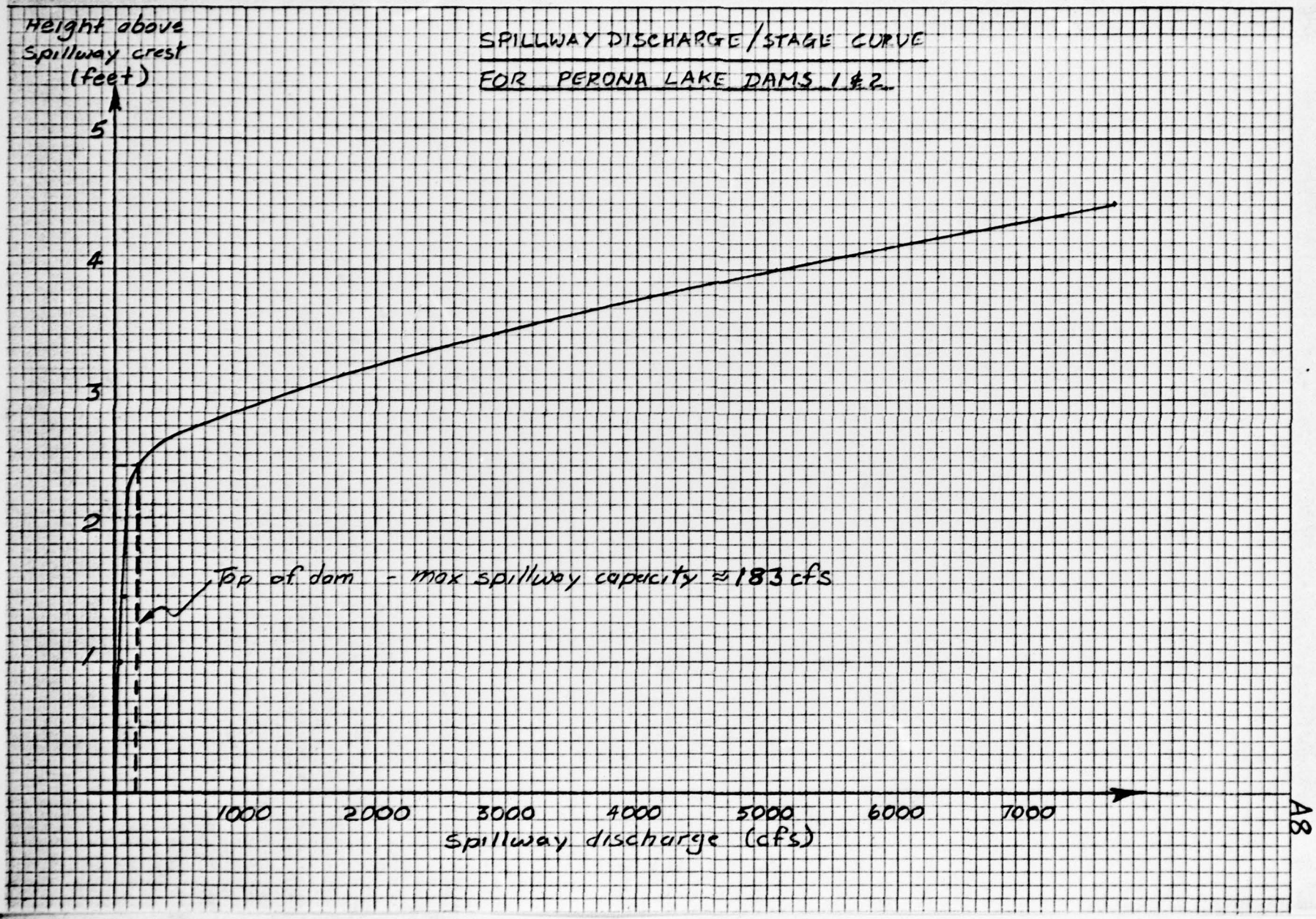
| H | C | Q |
|---|---|---|
| 0 | | |
| 1 | 2.7 | 2471 |
| 2 | 2.7 | 6988 |

$\Sigma Q$

| Elev. | H | Q |
|---|---|---|
| 754.7 | 0 | 0 |
| 755.7 | 1 | 48 |
| 756.2 | 1.5 | 88 |
| 757.2 | 2.5 | 183 |
| 758.2 | 3.5 | 2903 |
| 759.2 | 4.5 | 7649 |

Both Perona dams lie on the same lake, therefore both are considered in this hydraulic/hydrologic appendix. Perona dam #2 has no spillway therefore only dam overtopping is considered for this dam in the overall hydraulics

46 0706

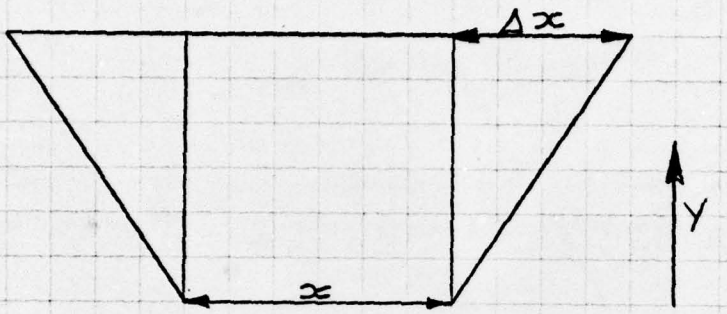


BY D.J.M. DATE 5-79
CHKD. BY ____ DATE ____
SUBJECT ____

**LOUIS BERGER & ASSOCIATES INC.**

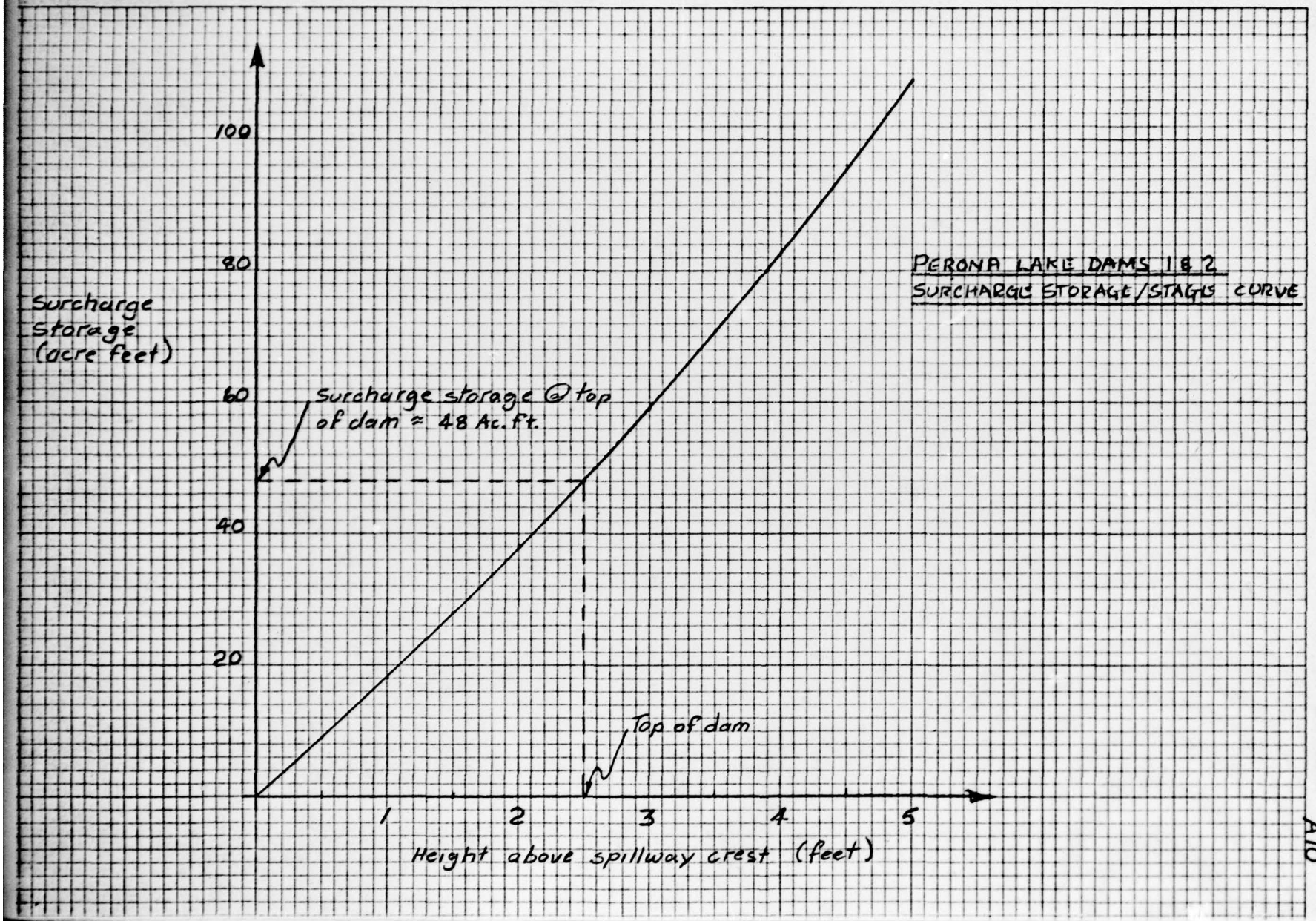
PERONA LAKE DAMS

SHEET NO. A9 OF
PROJECT C-234




Increment in volume $\Delta V = y(x + \Delta x)$

| Elev. (M.S.L) | Height above spillway crest | Surcharge storage (acre feet) |
|---|---|---|
| 754.7 | 0 | 0 |
| 755.2 | 0.5 | 9 |
| 755.7 | 1.0 | 18 |
| 756.2 | 1.5 | 28 |
| 756.7 | 2.0 | 38 |
| 757.2 | 2.5 | 48 |
| 757.7 | 3.0 | 59 |
| 758.2 | 3.5 | 71 |
| 758.7 | 4.0 | 83 |
| 759.2 | 4.5 | 96 |
| 759.7 | 5.0 | 109 |




PERONA LAKE DAMS 1 & 2
SURCHARGE STORAGE/STAGE CURVE

A10

BY D.J.M. DATE 5-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A11 OF
CHKD. BY ____ DATE ____ PERONA LAKE DAM #1 PROJECT C234
SUBJECT ____

GENERAL SUMMARY:

Length of dam = 740'
Effective length of spillway = 16'
Elev. of spillway crest = 754.7 ±

Spillway capacity @ El. 757.2 (top of dam) = 183 cfs

Surcharge storage @ top of dam = 48 Ac.ft.
storage @ normal pool = 101 Ac.ft.

∴ Maximum storage @ top of dam = 149 Ac.ft.

Lake area @ normal pool El. 754.7 = 17 Ac.
Lake area @ top of dam El. 757.2 = 22 Ac.

BY D.J.M. DATE 5-79. **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A12 OF.
CHKD. BY ..... DATE ..... PERONA LAKE DAMS PROJECT C234
SUBJECT Approximate drawdown time for Perona Lake

Volume of lake @ El. 754.7 ≈ 101 acre feet

Exit invert of pipe El. = 740.5 12" pipe
take head from top of pipe (El. 741.5)

Drawdown in three stages assuming vertical sides to lake

i) $H = 11$ $Q = 7$ cfs

$$\text{time} = \frac{101 \times 43560}{3 \times 7 \times 3600} = 58 \text{ hours}$$

ii) $H = 6.6$ $Q = 5.3$

$$\text{time} = \frac{101 \times 43560}{3 \times 5.3 \times 3600} = 76.7 \text{ hours}$$

iii) $H = 2.2$ $Q = 3$ cfs

$$\text{time} = \frac{101 \times 43560}{3 \times 3 \times 3600} = 132.8 \text{ hours}$$

$\Sigma$ time = (132.8 + 76.7 + 58) hours say 11 days

Q computed using the following formula for pipe flow:-

$$Q = \sqrt{\frac{100\, H_T}{\left(\frac{2.5204(1+K_e)}{D^4} + \frac{466.18\, n^2 L}{D^{16/3}}\right)}}$$

where: $n = 0.024$ $L = 73'$
$K_e = 0.5$ $H_T$ = head
D = diameter of pipe

Assumes no inflow and no tailwater

PERONA LAKE DAMS 1&2 INSPECTION C234
BY D.J.MULLIGAN
JUNE 4 1979

JOB SPECIFICATION

| NQ | NHR | NMIN | IDAY | IHR | IMIN | METRC | IPLT | IPRT | NSTAN |
|---|---|---|---|---|---|---|---|---|---|
| 150 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

JOPER: 3 NWT: 0

********** *********** ********** ********* **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR 100-YEAR FREQUENCY EVENT.

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 1 |

HYDROGRAPH DATA

| IHYDG | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -1 | 0.11 | 0.0 | 0.11 | 0.0 | 0.0 | 0 | 0 | 0 |

PRECIP DATA

| NP | STORM | DAJ | DAK |
|---|---|---|---|
| 72 | 0.0 | 0.0 | 0.0 |

PRECIP PATTERN

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| 0.02 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 0.03 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.10 | 0.10 | 0.10 | 0.10 |
| 0.10 | 0.13 | 0.23 | 0.24 | 0.48 | 0.80 | 0.42 | 0.23 | 0.14 | 0.13 |
| 0.10 | 0.10 | 0.10 | 0.10 | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 |
| 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 |
| 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| 0.02 | 0.02 | | | | | | | | |

LOSS DATA

| STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRTL | CNSTL | ALSMX | RTIMP |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0 | 1.00 | 0.0 | 0.0 | 1.00 | 0.25 | 0.10 | 0.0 | 0.0 |

GIVEN UNIT GRAPH, NUHGQ= 5

569. 227. 58. 16. 5.

UNIT GRAPH TOTALS 875. CFS OR 1.03 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

END-OF-PERIOD FLOW

| TIME | RAIN | EXCS | COMP Q |
|---|---|---|---|
| 1 | 0.02 | 0.00 | 0. |
| 2 | 0.02 | 0.00 | 0. |
| 3 | 0.02 | 0.00 | 0. |
| 4 | 0.02 | 0.00 | 0. |
| 5 | 0.02 | 0.00 | 0. |

| | | | |
|---|---|---|---|
| 6 | 0.02 | 0.00 | 0. |
| 7 | 0.02 | 0.00 | 0. |
| 8 | 0.02 | 0.00 | 0. |
| 9 | 0.02 | 0.00 | 0. |
| 10 | 0.02 | 0.00 | 0. |
| 11 | 0.02 | 0.00 | 0. |
| 12 | 0.02 | 0.00 | 0. |
| 13 | 0.03 | 0.01 | 8. |
| 14 | 0.02 | 0.01 | 10. |
| 15 | 0.03 | 0.02 | 16. |
| 16 | 0.03 | 0.02 | 18. |
| 17 | 0.03 | 0.02 | 19. |
| 18 | 0.03 | 0.02 | 19. |
| 19 | 0.03 | 0.02 | 19. |
| 20 | 0.03 | 0.02 | 19. |
| 21 | 0.03 | 0.02 | 19. |
| 22 | 0.04 | 0.03 | 25. |
| 23 | 0.04 | 0.03 | 27. |
| 24 | 0.04 | 0.03 | 27. |
| 25 | 0.05 | 0.04 | 33. |
| 26 | 0.05 | 0.04 | 36. |
| 27 | 0.10 | 0.09 | 65. |
| 28 | 0.10 | 0.09 | 76. |
| 29 | 0.10 | 0.09 | 79. |
| 30 | 0.10 | 0.09 | 80. |
| 31 | 0.10 | 0.09 | 80. |
| 32 | 0.13 | 0.12 | 97. |
| 33 | 0.23 | 0.22 | 161. |
| 34 | 0.24 | 0.23 | 191. |
| 35 | 0.48 | 0.47 | 336. |
| 36 | 0.80 | 0.79 | 575. |
| 37 | 0.42 | 0.41 | 446. |
| 38 | 0.23 | 0.22 | 274. |
| 39 | 0.14 | 0.13 | 164. |
| 40 | 0.13 | 0.12 | 123. |
| 41 | 0.10 | 0.09 | 93. |
| 42 | 0.10 | 0.09 | 83. |
| 43 | 0.10 | 0.09 | 81. |
| 44 | 0.10 | 0.09 | 80. |
| 45 | 0.06 | 0.05 | 57. |
| 46 | 0.05 | 0.04 | 43. |
| 47 | 0.05 | 0.04 | 38. |
| 48 | 0.04 | 0.03 | 31. |
| 49 | 0.04 | 0.03 | 29. |
| 50 | 0.03 | 0.02 | 22. |
| 51 | 0.03 | 0.02 | 20. |
| 52 | 0.03 | 0.02 | 19. |
| 53 | 0.03 | 0.02 | 19. |
| 54 | 0.03 | 0.02 | 19. |
| 55 | 0.03 | 0.02 | 19. |
| 56 | 0.03 | 0.02 | 19. |
| 57 | 0.02 | 0.01 | 13. |
| 58 | 0.02 | 0.01 | 11. |
| 59 | 0.02 | 0.01 | 10. |
| 60 | 0.03 | 0.02 | 16. |
| 61 | 0.02 | 0.01 | 12. |
| 62 | 0.02 | 0.01 | 11. |
| 63 | 0.02 | 0.01 | 10. |
| 64 | 0.02 | 0.01 | 10. |
| 65 | 0.02 | 0.01 | 10. |
| 66 | 0.02 | 0.01 | 10. |
| 67 | 0.02 | 0.01 | 10. |
| 68 | 0.02 | 0.01 | 10. |
| 69 | 0.02 | 0.01 | 10. |
| 70 | 0.02 | 0.01 | 10. |
| 71 | 0.02 | 0.01 | 10. |
| 72 | 0.02 | 0.01 | 10. |
| 73 | 0.0 | 0.0 | 4. |
| 74 | 0.0 | 0.0 | 1. |
| 75 | 0.0 | 0.0 | 0. |
| 76 | 0.0 | 0.0 | 0. |
| 77 | 0.0 | 0.0 | 0. |
| 78 | 0.0 | 0.0 | 0. |
| 79 | 0.0 | 0.0 | 0. |
| 80 | 0.0 | 0.0 | 0. |
| 81 | 0.0 | 0.0 | 0. |
| 82 | 0.0 | 0.0 | 0. |
| 83 | 0.0 | 0.0 | 0. |
| 84 | 0.0 | 0.0 | 0. |
| 85 | 0.0 | 0.0 | 0. |
| 86 | 0.0 | 0.0 | 0. |
| 87 | 0.0 | 0.0 | 0. |
| 88 | 0.0 | 0.0 | 0. |
| 89 | 0.0 | 0.0 | 0. |
| 90 | 0.0 | 0.0 | 0. |
| 91 | 0.0 | 0.0 | 0. |
| 92 | 0.0 | 0.0 | 0. |
| 93 | 0.0 | 0.0 | 0. |
| 94 | 0.0 | 0.0 | 0. |
| 95 | 0.0 | 0.0 | 0. |
| 96 | 0.0 | 0.0 | 0. |
| 97 | 0.0 | 0.0 | 0. |
| 98 | 0.0 | 0.0 | 0. |
| 99 | 0.0 | 0.0 | 0. |
| 100 | 0.0 | 0.0 | 0. |
| 101 | 0.0 | 0.0 | 0. |
| 102 | 0.0 | 0.0 | 0. |
| 103 | 0.0 | 0.0 | 0. |
| 104 | 0.0 | 0.0 | 0. |
| 105 | 0.0 | 0.0 | 0. |
| 106 | 0.0 | 0.0 | 0. |
| 107 | 0.0 | 0.0 | 0. |
| 108 | 0.0 | 0.0 | 0. |
| 109 | 0.0 | 0.0 | 0. |
| 110 | 0.0 | 0.0 | 0. |
| 111 | 0.0 | 0.0 | 0. |
| 112 | 0.0 | 0.0 | 0. |
| 113 | 0.0 | 0.0 | 0. |
| 114 | 0.0 | 0.0 | 0. |
| 115 | 0.0 | 0.0 | 0. |
| 116 | 0.0 | 0.0 | 0. |
| 117 | 0.0 | 0.0 | 0. |
| 118 | 0.0 | 0.0 | 0. |
| 119 | 0.0 | 0.0 | 0. |
| 120 | 0.0 | 0.0 | 0. |
| 121 | 0.0 | 0.0 | 0. |
| 122 | 0.0 | 0.0 | 0. |
| 123 | 0.0 | 0.0 | 0. |
| 124 | 0.0 | 0.0 | 0. |
| 125 | 0.0 | 0.0 | 0. |
| 126 | 0.0 | 0.0 | 0. |
| 127 | 0.0 | 0.0 | 0. |

| | | | | |
|---|---|---|---|---|
| 128 | 0.0 | 0.0 | 0. | |
| 129 | 0.0 | 0.0 | 0. | |
| 130 | 0.0 | 0.0 | 0. | |
| 131 | 0.0 | 0.0 | 0. | |
| 132 | 0.0 | 0.0 | 0. | |
| 133 | 0.0 | 0.0 | 0. | |
| 134 | 0.0 | 0.0 | 0. | |
| 135 | 0.0 | 0.0 | 0. | |
| 136 | 0.0 | 0.0 | 0. | |
| 137 | 0.0 | 0.0 | 0. | |
| 138 | 0.0 | 0.0 | 0. | |
| 139 | 0.0 | 0.0 | 0. | |
| 140 | 0.0 | 0.0 | 0. | |
| 141 | 0.0 | 0.0 | 0. | |
| 142 | 0.0 | 0.0 | 0. | |
| 143 | 0.0 | 0.0 | 0. | |
| 144 | 0.0 | 0.0 | 0. | |
| 145 | 0.0 | 0.0 | 0. | |
| 146 | 0.0 | 0.0 | 0. | |
| 147 | 0.0 | 0.0 | 0. | |
| 148 | 0.0 | 0.0 | 0. | |
| 149 | 0.0 | 0.0 | 0. | |
| 150 | 0.0 | 0.0 | 0. | |
| SUM | 5.20 | 4.35 | 3892. | |

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 575. | 54. | 26. | 26. | 3896. |
| INCHES | | 4.58 | 4.58 | 4.58 | 4.58 |
| AC-FT | | 27. | 27. | 27. | 27. |

**********

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME |
|---|---|---|---|---|---|---|
| 11 | 1 | 0 | 0 | 0 | 0 | 1 |

ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME |
|---|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 1 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STORAGE= | 0. | 18. | 28. | 38. | 48. | 59. | 71. | 96. |
| OUTFLOW= | 0. | 48. | 88. | 131. | 183. | 1180. | 2903. | 7649. |

| TIME | EOP STOR | AVG IN | EOP OUT |
|---|---|---|---|
| 1 | 0. | 0. | 0. |
| 2 | 0. | 0. | 0. |
| 3 | 0. | 0. | 0. |
| 4 | 0. | 0. | 0. |
| 5 | 0. | 0. | 0. |
| 6 | 0. | 0. | 0. |
| 7 | 0. | 0. | 0. |
| 8 | 0. | 0. | 0. |
| 9 | 0. | 0. | 0. |
| 10 | 0. | 0. | 0. |

BY D.J.M DATE 6-79

CHKD. BY DATE

SUBJECT

# LOUIS BERGER & ASSOCIATES INC.

PERONA LAKE DAMS 1 & 2

SHEET NO. A-16 OF

PROJECT C-234

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11 | 0. | 0. | 0. | 72 | 14. | 10. | 38. |
| 12 | 0. | 0. | 0. | 73 | 14. | 7. | 37. |
| 13 | 0. | 4. | 0. | 74 | 14. | 2. | 37. |
| 14 | 0. | 9. | 0. | 75 | 14. | 1. | 36. |
| 15 | 0. | 13. | 0. | 76 | 13. | 0. | 35. |
| 16 | 0. | 17. | 1. | 77 | 13. | 0. | 35. |
| 17 | 0. | 18. | 1. | 78 | 13. | 0. | 34. |
| 18 | 1. | 19. | 1. | 79 | 13. | 0. | 34. |
| 19 | 1. | 19. | 2. | 80 | 12. | 0. | 33. |
| 20 | 1. | 19. | 2. | 81 | 12. | 0. | 32. |
| 21 | 1. | 19. | 2. | 82 | 12. | 0. | 32. |
| 22 | 1. | 22. | 3. | 83 | 12. | 0. | 31. |
| 23 | 1. | 26. | 3. | 84 | 11. | 0. | 31. |
| 24 | 1. | 27. | 4. | 85 | 11. | 0. | 30. |
| 25 | 2. | 30. | 4. | 86 | 11. | 0. | 30. |
| 26 | 2. | 35. | 5. | 87 | 11. | 0. | 29. |
| 27 | 2. | 50. | 5. | 88 | 11. | 0. | 28. |
| 28 | 2. | 70. | 7. | 89 | 10. | 0. | 28. |
| 29 | 3. | 78. | 8. | 90 | 10. | 0. | 27. |
| 30 | 3. | 80. | 9. | 91 | 10. | 0. | 27. |
| 31 | 4. | 80. | 11. | 92 | 10. | 0. | 26. |
| 32 | 4. | 89. | 12. | 93 | 10. | 0. | 26. |
| 33 | 5. | 129. | 14. | 94 | 10. | 0. | 25. |
| 34 | 6. | 176. | 17. | 95 | 9. | 0. | 25. |
| 35 | 8. | 264. | 22. | 96 | 9. | 0. | 25. |
| 36 | 11. | 456. | 29. | 97 | 9. | 0. | 24. |
| 37 | 14. | 511. | 38. | 98 | 9. | 0. | 24. |
| 38 | 17. | 360. | 44. | 99 | 9. | 0. | 23. |
| 39 | 18. | 219. | 47. | 100 | 9. | 0. | 23. |
| 40 | 18. | 143. | 49. | 101 | 8. | 0. | 22. |
| 41 | 19. | 108. | 51. | 102 | 8. | 0. | 22. |
| 42 | 19. | 88. | 52. | 103 | 8. | 0. | 22. |
| 43 | 19. | 82. | 53. | 104 | 8. | 0. | 21. |
| 44 | 19. | 81. | 54. | 105 | 8. | 0. | 21. |
| 45 | 20. | 69. | 54. | 106 | 8. | 0. | 20. |
| 46 | 19. | 50. | 54. | 107 | 8. | 0. | 20. |
| 47 | 19. | 40. | 54. | 108 | 7. | 0. | 20. |
| 48 | 19. | 35. | 53. | 109 | 7. | 0. | 19. |
| 49 | 19. | 30. | 52. | 110 | 7. | 0. | 19. |
| 50 | 19. | 25. | 52. | 111 | 7. | 0. | 19. |
| 51 | 19. | 21. | 51. | 112 | 7. | 0. | 18. |
| 52 | 18. | 19. | 50. | 113 | 7. | 0. | 18. |
| 53 | 18. | 19. | 49. | 114 | 7. | 0. | 18. |
| 54 | 18. | 19. | 48. | 115 | 6. | 0. | 17. |
| 55 | 18. | 19. | 48. | 116 | 6. | 0. | 17. |
| 56 | 18. | 19. | 47. | 117 | 6. | 0. | 17. |
| 57 | 17. | 16. | 47. | 118 | 6. | 0. | 16. |
| 58 | 17. | 12. | 46. | 119 | 6. | 0. | 16. |
| 59 | 17. | 11. | 45. | 120 | 6. | 0. | 16. |
| 60 | 17. | 13. | 45. | 121 | 6. | 0. | 16. |
| 61 | 17. | 14. | 44. | 122 | 6. | 0. | 15. |
| 62 | 16. | 12. | 44. | 123 | 6. | 0. | 15. |
| 63 | 16. | 11. | 43. | 124 | 6. | 0. | 15. |
| 64 | 16. | 10. | 42. | 125 | 5. | 0. | 14. |
| 65 | 16. | 10. | 42. | 126 | 5. | 0. | 14. |
| 66 | 15. | 10. | 41. | 127 | 5. | 0. | 14. |
| 67 | 15. | 10. | 41. | 128 | 5. | 0. | 14. |
| 68 | 15. | 10. | 40. | 129 | 5. | 0. | 13. |
| 69 | 15. | 10. | 40. | 130 | 5. | 0. | 13. |
| 70 | 15. | 10. | 39. | 131 | 5. | 0. | 13. |
| 71 | 14. | 10. | 39. | 132 | 5. | 0. | 13. |

| | | | | |
|---|---|---|---|---|
| 133 | 5. | 0. | 12. | |
| 134 | 5. | 0. | 12. | |
| 135 | 5. | 0. | 12. | |
| 136 | 4. | 0. | 12. | |
| 137 | 4. | 0. | 12. | |
| 138 | 4. | 0. | 11. | |
| 139 | 4. | 0. | 11. | |
| 140 | 4. | 0. | 11. | |
| 141 | 4. | 0. | 11. | |
| 142 | 4. | 0. | 11. | |
| 143 | 4. | 0. | 10. | |
| 144 | 4. | 0. | 10. | |
| 145 | 4. | 0. | 10. | |
| 146 | 4. | 0. | 10. | |
| 147 | 4. | 0. | 10. | |
| 148 | 4. | 0. | 9. | |
| 149 | 3. | 0. | 9. | |
| 150 | 3. | 0. | 9. | |
| SUM | | | 3404. | |

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 54. | 37. | 23. | 23. | 3404. |
| INCHES | | 3.15 | 4.00 | 4.00 | 4.00 |
| AC-FT | | 18. | 23. | 23. | 23. |

RUNOFF SUMMARY, AVERAGE FLOW

| | | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | AREA |
|---|---|---|---|---|---|---|
| HYDROGRAPH AT | 1 | 595. | 54. | 26. | 26. | 0.11 |
| ROUTED TO | 11 | 54. | 37. | 23. | 23. | 0.11 |